

in 1817; (3) a facsimile of one of the thirteen synoptic charts prepared by Elias Loomis in 1843, in connection with his investigation of two storms that occurred in 1842; (4) the weather chart, with isobars, that Le Verrier published in France on September 11, 1863, as the first daily weather chart on the basis of telegraphic reports; (5) the chart, with isobars, which is twelve years older than Le Verrier's, being that which was published daily for sometime in the year 1851, during the World's Fair at London; (6) a facsimile of the first chart of average isobars for any country, being that published for France in 1864 by Renou.

These reprints by Dr. Hellmann awaken one's interest in the history of the development of meteorology, and we can but hope that, in the abundance of his knowledge of ancient literature, he will discover some early American works that are worthy of being reprinted among his classics.

MEXICAN CLIMATOLOGICAL DATA.

In order to extend the isobars and isotherms southward so that the students of weather, climate and storms in the United States may properly appreciate the influence of the conditions that prevail over Mexico the Editor has translated the following tables from the current numbers of the *Boletín Mensual* as published by the Central Meteorological Observatory of Mexico. The data there given in metric measures have been converted into English measures. The barometric means are as given by mercurial barometers under the influence of local gravity, and therefore need reductions to standard gravity, depending upon both latitude and altitude; the influence of the latter is rather uncertain, but that of the former is well known. For the sake of conformity with the other data published in this REVIEW these corrections for local gravity have not been applied. One additional station, Topolobampo, is published at the end of Table II.

Mexican data for December, 1896.

Stations.	Altitude.	Mean barometer.	Temperature.			Relative humidity.	Precipitation.	Prevailing direction.	
			Max.	Min.	Mean.			Wind.	Cloud.
	<i>Feet.</i>	<i>Inch.</i>	<i>° F.</i>	<i>° F.</i>	<i>° F.</i>	<i>%</i>	<i>Inch.</i>		
Agua Calientes	6,112	23.86	85.1	38.4	59.4	36	0.00	n.	
Campeche									
Colima (Seminario) ..	1,600								
Colima					75.4				
Culliacan	112								
Guadalupe (O. d. E.) ..	5,141	25.08	77.0	29.8	57.6	86	0.00	nw.	w.
Guanaquato	6,761	23.73	73.8	37.2	55.6	48	1.50	T. sw.	sw.
Jalapa	4,767	25.02	87.8	42.8	57.4	80	1.50	n.	
Lagos (L. G.)	6,276	24.19	77.5	35.5	54.0	68	0.00	ne.	ne.
Leon	5,901	24.35	74.8	27.7	54.5	51	0.00	ssw.	sw.
Magdalena (Sonora) ..			68.0	50.0	59.0		1.73	nne.	n.
Mazatlan	25	29.96	83.1	61.3	73.9	64	T.	nw.	sw.
Merida	50	30.04	89.8	55.4	71.6	76	2.09	ne.	sw.
Mexico (Obs. Cent.) ..	7,489	23.11	71.6	34.7	53.0	61	0.61	nw.	sw.
Mexico (E. N. de S.) ..	7,480								
Morelia (Seminario) ..	6,401	24.01	78.4	34.7	53.8	67	0.33	ne.	w.
Oaxaca	5,164	25.13	81.9	37.6	61.0	62	0.76	nw.	ne.
Pabellon	6,312								
Pachuca	7,956	22.56	73.0	38.8	50.5	64	0.00	nne.	ne.
Puebla (Col. d. Est.) ..	7,118								
Puebla (Col. Cat.)	7,112	23.33	75.2	35.2	55.0	65	0.53	e.	ne.
Queretaro	6,070								
Saltillo (Col. S. Juan) ..	5,377								
San Luis Potosi	6,302	24.20	70.7	31.3	54.4	65	0.14	e.	w.
Silao	6,083	24.34	69.6	40.3	57.2	65	T.	w.	sw.
Tacámbaro									
Tacubaya (Obs. Nac.) ..	7,630								
Tampico (Hos. Mil.) ..	38								
Tehuacan	5,458								
Toluca	6,613	21.93	68.7	35.2	49.1	63	1.08		
Trejo (H. de S., Gto.) ..	6,011						0.00	e.	
Trinidad	6,011								
Veracruz	48								
Zacatecas	8,015	22.55	74.8	34.8	52.0	58	0.00	ne.	ne.
Zapotlan (Seminario) ..	5,126								

*Trejo appears to have the same altitude as the next station, Trinidad, but this may be a typographical error in the December *Boletín*.
†Trinidad is 14 kilometers east-southeast of Leon.

ANNUAL MEANS FOR 1895.

The following table is taken from the general synopsis published in the *Boletín Mensual* for December, 1896, page 171,

which is a summary of the annual tables published at occasional intervals in the *Boletín* during the past year. A corresponding synopsis for 1896 will, doubtless, also soon become available. These annual summaries are essential as a basis for the reduction of the pressure and temperature to sea level, which reduction must be carried out for normal and annual values before discussing monthly means or individual observations. The altitudes here given are taken from the respective annual tables from which this synopsis is quoted; unfortunately they differ sometimes from the altitudes given in the monthly tables for 1896, but we may not go far wrong in assuming that the barometers have remained in the same location during both these years and that the changes in the figures are simply the result of a revision of the adopted altitudes. Nothing is published as to the manner in which these altitudes have been determined, possibly many of them may be the result of barometric computations, in which case the reduced pressures will have a corresponding uncertainty. In accordance with the other Mexican data the barometric means have not been reduced to standard gravity and, in fact, the values of local gravities at the respective stations is, as yet, not known by actual observation but may be approximately computed by Mr. Putnam's formula, as given on page 463 of the MONTHLY WEATHER REVIEW for December, 1896.

Annual synopsis for 1895; Mexican stations.

Stations.	Altitude for 1896.	Barometer (mean).	Temperature.			Mean humidity.	Days with rain.	Total precipitation.	Wind prevailing direction.	Clouds.	
			Mean annual.	Maximum (absolute).	Minimum (absolute).					Mean cloudiness.	Prevailing direction.
Guanajuato	6,640	23.66	65.5	91.9	36.0	48	100	23.68	ssw.	40	ne.
Jalapa	4,757	25.55	63.5	91.0	33.8	52	147	51.30	nne.	44	sw.
Leon	5,901	24.29	65.7	91.0	32.0	47	113	30.92	n.	34	sw.
Mazatlan	25	29.92	76.8	104.5	56.8	77	75	42.85	n.	47	sw.
Merida	50	29.95	78.4	94.9	47.8	71	97	29.29	ne.	47	se.
Mexico	7,473	23.07	60.3	87.8	32.9	57	145	22.01	n.	50	ne.
Morelia	6,401	23.96	61.9	93.7	37.4	63	185	32.06	ssw.	49	w.
Oaxaca	5,164	25.11	69.4	90.2	39.2	61	106	28.08	w.	44	e.
Pachuca	7,956	22.50	57.9	88.8	32.4	50	106	10.86	nne.	37	ne.
Puebla	7,118	23.35	60.6	91.4	32.0	60	113	23.55	ne.	45	n.
Puebla (Col. Cat.)	7,112	23.37	63.0	90.1	37.6	60	134	27.09	e.	37	se.
Queretaro	6,070	24.18	64.9	90.2	32.9	59	67	9.45	e.		
Real d. Montel	9,085	21.59	55.4	89.6	31.6	58	82	24.45		37	
Saltillo	5,377	24.85	63.7	90.2	31.8	72	77	23.46	ne.	33	n.
San Luis Potosi	6,302	24.14	63.9	90.4	26.1	59	64	11.25	e.	41	w.
Tacubaya	7,630	22.97	58.6	81.5	26.6	61	136	24.72	nw.	44	sw.
Toluca	6,613	21.91	54.9	90.0	24.4	59	154	26.16	ws.	44	sw.
Zacatecas	8,129	22.54	60.1	91.0	19.0	55	64	10.70	sw.	36	se.

*These altitudes for 1895 differ from those published in the respective monthly summaries for 1896. In the absence of positive information it may be assumed that the barometers were not removed, but that the adopted altitudes have been revised from time to time.

†This station does not appear among the monthly summaries of 1896.
‡The monthly and annual barometric means are published to the nearest tenth of a millimeter, but for all other stations to the nearest hundredth.

§Sw. & wsw.

METEOROLOGY IN THE PUBLIC SCHOOLS.

In the MONTHLY WEATHER REVIEW for December, 1895, Vol. XXIII, page 458, the Editor has referred to the excellent results attained in school work by utilizing, as a basis for discussion and mental training, such elementary observations of the weather as can be made by any child. When the scholars in any class are encouraged to keep personal diaries and notes of atmospheric phenomena their perceptive faculties are rapidly developed; when these diaries are compared and the ideas that are suggested by the pupils are discussed under the leadership of a wise teacher, the analytical faculties of the mind are developed, the study of nature is encouraged, erroneous ideas are supplanted by careful generalizations, and experience comes to be esteemed more highly than inherited myths and legends. The highest development of this method of studying meteorology will undoubtedly be

found in those high schools and colleges that pursue the course of study laid out in Davis' Elementary Meteorology; but for the lower grades of public schools a teacher who has at hand the text-books by Waldo, Davis, Russell, or any other of the numerous recent authors, will prefer to mark out a course of observation and study that requires no text-book in the hands of the scholar, except his own daily record and the daily map of the Weather Bureau. In this case the scholar looks to the teacher entirely for his mental stimulus, the teaching is done entirely by personal observations and verbal discussions; the teacher, as it were, pries into the scholar's thoughts, finds out the errors that he is liable to make, and helps him to discover the truth for himself. He does not cram the scholar, but leads him to think for himself and find his own way out of the woods. This process is infinitely superior to the ordinary text-book method, but, of course, it implies very careful leadership on the part of the teacher.

To schools that adopt this method of teaching the circular that has just been sent out by a committee at Cambridge, Mass., will come as a welcome stimulus. The schools that can show the best work done, or the best record of work done in the study of weather and climate, will doubtless be proud to carry off the prize offered by the committee, whose circular reads as follows:

PRIZES FOR SCHOOL WORK ON WEATHER AND CLIMATE.

On the dissolution of the New England Meteorological Society, in 1896, a sum of about \$100 was left in the hands of the undersigned committee to be used "for some meteorological purpose." In order to carry out the wishes of the society the committee offers three annual prizes of \$12, \$10, and \$8 for the best work on weather and climate in any New England public school below the high school, according to conditions stated below. The prizes will be awarded to the school, not to the scholars. It is hoped that the fund will be enlarged by subscription, so that the prizes may be continued for a number of years.

The prizes will be awarded by judges to be selected at a later date. Each competing school may submit the work of three pupils selected by the teacher from the work of a single class.

All papers and record books sent are to be wholly the work of the pupils whose names they bear; all records are to be the result of the pupils' own observation; the papers received will be taken to represent the best products of work done by an entire class, that is, all members of the class are to do work similar to that of the three pupils whose papers are forwarded to the committee.

With the work of each pupil a paper should be sent stating (1) name of pupil; (2) age, in years and months; (3) name of school and grade or class (counting first year in school as first grade, second year, second grade, etc.); (4) name of teacher; (5) town or city, and State.

The committee does not desire to limit the work closely or to require uniformity. The work may be done as special study in weather and climate, or it may be part of a course in nature study or in geography. But the committee suggests the following topics as appropriate:

(1) Observation and record of simple weather elements.
(2) Preparation of weather maps based on data supplied by the teacher.

(3) The use of weather maps and of local observations in simple weather predictions.

(4) Special observation and study of the elements that control the climate of New England.

The judges will make due allowance for the age of pupils and their school grade, and will award the prizes on the basis of quality of work in whatever subject the teacher may choose, bearing directly on weather and climate. Owing to the late date at which this circular is issued, work covering only the second half of the school year, 1896-97, will be accepted in the first competition.

The papers submitted should be received in Cambridge by July 10, 1897. Address: Prof. W. M. Davis, Museum, Cambridge, Mass. Express charges or postage should be fully prepaid. If it is desired to have the papers returned full directions should be given for post office or express address; and if return by mail is desired, stamps for postage should be inclosed.

The committee will be glad to give further information, if desired.

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W. M. DAVIS,

Professor of Geology at Harvard University.

R. DE C. WARD,

Professor of Meteorology at Harvard University.

CAMBRIDGE, MASS., January, 1897.

LIQUID AIR.

The students of chemistry are familiar with the fact that a century ago Lavoisier foresaw the novel chemical results that would be realized if ever we should be able to cool and compress gases down to the point of liquefaction, but the realization of his ideas was reserved for the present generation of physicists. Faraday and Thilorier first distinguished themselves by the production of liquid and solid carbonic acid gas, but a later generation, Pictet in Geneva, Cailletet in Paris, Olzeffski and Wroblenski in Cracow, Ramsay and Dewar in London, have reduced many other gases, including oxygen, nitrogen, and, possibly, hydrogen to the liquid condition. Improvements and simplifications in the apparatus have been made from time to time, but it seems to have attained its simplest and most efficient construction in the hands of Dr. Karl Linde, Professor of Applied Thermo-dynamics in the Royal Bavarian Technical High School at Munich. The simple principles of thermo-dynamics which underlie Dr. Linde's apparatus are, in fact, of daily application in the workings of the free atmosphere itself. When any portion of the atmosphere is pushed up to a higher level it cools by expansion, that is to say, the internal molecular energy called heat is drawn upon to do external work or heat is transformed into work and the mass of gas from which the heat is thus withdrawn necessarily cools; vice versa, when air is brought down to a lower level it is compressed by the weight of the additional atmosphere above it and is warmed, that is to say, external work is done upon it, just as when we hammer a piece of lead a portion, or in the case of the air, all the external work is converted into heat.

We are indebted to Mr. O. L. Fassig for an early number of the *Vossische Zeitung* of Berlin, January 12, 1897, containing the following account of a recent public lecture by Prof. Dr. Karl Linde before the Berlin Association of Engineers, illustrating as it does the results of a special application of processes that go on daily before our eyes in the free atmosphere, these experiments must, therefore, have as much interest for the meteorologist as they have for the physicist. In the early part of this century "the cold of elevation" was often spoken of without any clear conception of the fact that in the process of elevation the air is cooled by the internal work done in expansion; generally it would seem that the air was supposed to cool by contact with the ground or by mixture with other colder air. Physicists knew that gases cooled by expansion, but Espy seems to have been the first who realized the importance to meteorology of both expansion and compression. Probably we are not even yet ready to accept the widest application of the principles of warming by compression, although the fullest range is given to those who invoke the cooling by expansion. In fact, however, whether the air ascends in small masses, as in tornadoes, or in large masses, as in the passage of westerly winds over the Andes and the Rocky Mountains, there must be a corresponding amount of descending air, and this must be warmed by compression. The air that ascends and cools in the equatorial regions, like the air that ascends and cools on the easterly side of an area of low pressure, must have a counterbalancing mass of descending air somewhere within the atmosphere. If in one region the cooling due to expansion is partially counterbalanced by the warming due to the evolution of the latent heat of the moisture that is condensed by the cooling, then in some other region, and to an equivalent extent, the warming of this same air by compression as it subsequently descends must be partially counterbalanced by some cooling process, such as the radiation of heat from the gas, or from the vapor or the dust that it contains. If this were not the case, we should be liable to extremely high temperatures whenever and wherever a mass of air descends. Illustrations of rapid descent and consequently warm weather are to be found not